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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/039,333	11/09/2001	Gene H. Lee	5545 (2616-012)	1508

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APPLIED MATERIALS, INC.  
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SANTA CLARA, CA 95050

EXAMINER

TRAN, BINH X

ART UNIT PAPER NUMBER

1765

DATE MAILED: 02/27/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

# Office Action Summary

Application No.

10/039,333

Applicant(s)

LEE ET AL.

Examiner

Binh X Tran

Art Unit

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --  
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

## Status

- 1) ☒ Responsive to communication(s) filed on 07 November 2003.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

## Disposition of Claims

- 4) ☒ Claim(s) 1-21 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-21 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

## Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

## Priority under 35 U.S.C. §§ 119 and 120

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).  
a) ☐ All b) ☐ Some \* c) ☐ None of:  
1. ☐ Certified copies of the priority documents have been received.  
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.  
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).  
\* See the attached detailed Office action for a list of the certified copies not received.
- 13) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application) since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.  
a) ☐ The translation of the foreign language provisional application has been received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121 since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

## Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892) 4) ☐ Interview Summary (PTO-413) Paper No(s). \_\_\_\_\_
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948) 5) ☐ Notice of Informal Patent Application (PTO-152)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) \_\_\_\_\_ 6) ☐ Other: \_\_\_\_\_

## DETAILED ACTION

### ***Claim Rejections - 35 USC § 102***

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

2. Claims 1-4, 7-8 are rejected under 35 U.S.C. 102(b) as being anticipated by Kumar et al. (EP 0837497 A2).

Kumar discloses a plasma etching a tungsten-containing layer (16, i.e. tungsten silicide) having a patterned hard mask (18) comprising:

placing the substrate in a plasma zone;

introducing into a plasma zone a process gas mix comprising  $\text{NF}_3$  and  $\text{Cl}_2$  (col. 4 lines 23-28);

forming a plasma from the process gas mix to etch the tungsten-containing layer substantially anisotropically (Fig 1-2, col. 3).

Kumar does not explicitly state that the etch rate of tungsten-containing layer is greater than the etch rate of the hard mask. However, Kumar discloses that the etch rate of tungsten-containing layer and polysilicon is about the same (i.e. selectivity 1:1, col. 3 lines 8-10). Kumar also discloses that the polysilicon is etched at a greater rate than hard mask (selectivity 5:1, col. 3 lines 11-14). Base on this information, the

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examiner interprets that Kumar implicitly discloses the etch rate of tungsten-containing layer is greater (more specific 5 times faster) than the etch rate the hard mask.

Respect to claims 2-3, the examiner interprets that Kumar discloses the tungsten containing layer is etched at an etch rate about 5 times faster than the hard mask (read on the limitation "at an etch rate at least twice ..." and/or "2.5 greater than..."). Respect to claim 4, Kumar discloses that variation in etch uniformity of 3% or less, etch rate microloading was less than 3% (read on "critical dimension loss of less than 4%") and sidewalls angle close to 90 ° (col. 3 lines 13-17, col. 5 lines 10-15). Respect to claim 7, Kumar discloses the gas mix consist essentially of  $\text{NF}_3$  and  $\text{Cl}_2$  (col. 7 lines 20-25). Respect to claim 8, Kumar discloses the process gas mix further comprise a passivator gas (col. 2 line 39-43).

### ***Claim Rejections - 35 USC § 103***

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

4. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to

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consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

5. Claims 5-6, 9-18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kumar in view of Qian et al. (US 6,136,211).

Claims 5-6 differ from Kumar by the specific volumetric flow ratio of  $\text{NF}_3:\text{Cl}_2$ . In an etching method, Qian teaches the volumetric flow ratio of  $\text{NF}_3:\text{Cl}_2$  is a result effective variable (col. 4 lines 20-29). The result effective variable is commonly determined by routine experiment. The process of conducting routine experiments so as to produce an expected result is obvious to one of ordinary skill in the art. Hence, it would have been obvious to one having ordinary skill in the art, at the time of invention, modify Kumar in view of Qian by performing routine experiments to obtain optimal flow ratio.

Respect to claim 9, Kumar fails to disclose that the hard mask layer comprises silicon nitride. However, Kumar discloses the hard mask layer is made of silicon oxide. Qian teaches that the hard mask layer can be either silicon oxide or silicon nitride (col. lines 12-14, col. 8 lines 24-26). It would have been obvious to one having ordinary skill in the art, at the time of invention, to modify Kumar in view of Qian by using silicon nitride hard mask because equivalent and substitution of one for the other would produce an expected result.

Respect to claim 10, Kumar discloses the step of applying the energy to the coils and the electrode to ionize the process gas (Fig 3A). However, Kumar fails to explicitly disclose applying the RF energy to the inductor coil. Qian discloses the step of applying RF energy (110, 155) to the inductor coil (115) and process electrodes. It would have

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been obvious to one having ordinary skill in the art, at the time of invention, to modify Kumar and Qian by applying RF energy to inductor coil and process electrodes because it will directly increase plasma density over the substrate. The limitations of claims 11-18 have been discussed above.

5. Claims 19-21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kumar and Qian, and further in view of Davis (US 5,164,330).

Respect to claim 19, Kumar and Qian fail to disclose an over etch process mix comprising Ar and Cl<sub>2</sub>. However, Kumar clearly disclose the over etch process using a gas mixture comprises Cl<sub>2</sub> (col. 4 lines 44-62). In a plasma etching, Davis discloses an over etch process using Ar and Cl<sub>2</sub> (col. 6-7). It would have been obvious to one having ordinary skill in the art, at the time of invention to modify Kumar and Qian by performing an over etch process using Ar and Cl<sub>2</sub> because it will effective remove the tungsten. Further, equivalent and substitution of one for the other would produce an expected result.

The limitations of claims 20-21 have been discussed above.

### ***Response to Arguments***

6. Applicant's arguments with respect to claims 1-21 have been considered but are moot in view of the new ground(s) of rejection.

### ***Conclusion***

7. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Binh X Tran whose telephone number is (571) 272-

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1469. The examiner can normally be reached on Monday-Thursday and every other Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nadine G Norton can be reached on (571) 272-1465. The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9306.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0661.

Binh X. Tran

**NADINE G. NORTON**  
**SUPERVISORY PATENT EXAMINER**

